the scientist much inspiration for further research and investigation. R. VON HUHN

NEW YORK

SPECIAL ARTICLES

THE HEREDITY OF SUSCEPTIBILITY TO A TRANSPLANTABLE SARCOMA (J. W. B.) OF THE JAPANESE WALTZING MOUSE

IN 1916[1] the writer in collaboration with Tyzzer reported on the inheritance of susceptibility to a transplantable carcinoma (J. W. A.) of the Japanese waltzing mouse. This tumor grew in one hundred per cent. of the Japanese waltzing mice inoculated and in zero per cent. of the common non-waltzing mice. When these two races were crossed, the F_1 generation hybrids showed sixty-one out of sixty-two mice to be susceptible. In these mice growth was as rapid if not more so than in the Japanese waltzing mice themselves. The one exception may well have been due to faulty technique for a reinoculation test was not made.

The F_2 generation gave a very interesting result—only three out of 183 mice grew the tumor. At that time the results were explained on the basis of multiple Mendelizing factors[2] whose number was estimated at from twelve to fourteen. *Simultaneous presence* of these factors, themselves introduced by the Japanese waltzing race, was considered necessary for progressive growth of the tumor. The analogy between this case and that of coat color in wild mice, dependent upon the simultaneous presence of at least five known Mendelizing factors was at that time pointed out.

Later[3] while working with a transplantable sarcoma (J. W. B.) of the Japanese waltzing mouse, results were obtained which showed what semed to be a somewhat simpler quantitative condition of the same process. In this case, the parent races and F_1 hybrids behaved as before, but the F_2 hybrids gave a total of twenty-three susceptible, to sixty-six non-susceptible animals. It was previously estimated that from five to seven factors were involved. In order to determine more closely the number of factors, new experiments were devised as follows: F_1 hybrid mice themselves susceptible were crossed back with the non-susceptible parent race. This has recently given a back cross generation whose susceptibility would depend upon the factors introduced through the gametes received from their F_1 parent. If one factor was involved, the ratio of gametes containing it formed by the F_1 animal, to those lacking it would be 1:1, if two factors, 1:3; if three factors 1:7; if four factors, 1:15; if five factors, 1:31; if six factors, 1:63; and if seven factors, 1:127. Susceptible and non-susceptible *individuals* would occur in the back cross generation in similar proportions.

The actual numbers obtained were twenty one susceptible to 208 non-susceptible. This result may be compared with expectations on three, four, five, and seven factor hypotheses, as follows:

	Susceptible	Non-susceptible	Ratio
Expected 3 factor....	28	201	1:7
Observed	21	208	1:90
Expected 4 factor....	14	215	1:15
Expected 5 factor....	7	222	1:31
Expected 7 factor....	1.8	227.2	1:127

The observed figures fall between the three and four factor hypothesis. The numbers are not large enough to give a definite test, but the F_2 generation already mentioned is interesting as a supporting line of evidence. If we compare this with the expectation, we find that the observed figures lie between the

	Susceptible	Non-susceptible	Ratio
Expected 3 factor....	39	50	1:1.3
Expected 4 factor....	29	60	1:2.1
Observed	23	66	1:2.8
Expected 5 factor....	21	68	1:3.2

four and five factor hypothesis. In both cases the four factor hypothesis figures are close and the three and five factor hypothesis

[1] Little, C. C., and Tyzzer, E. E., 1916, *Jour. Med. Research*, 33: 393.

[2] Little, C. C., SCIENCE, N. S., 1914, 40, 904.

[3] Tyzzer, E. E., and Little, C. C., 1916, *Jour. Cancer Research*, 1: 387, 388.

are to be still considered as possibilities, though not probabilities. The six and seven factor hypotheses appear to be definitely eliminated.

The non-susceptible back cross animals which should by the multiple factor hypothesis contain in many cases part, but not all, of the factors for susceptibility are being tested by breeding back with the F_1 animals. If four factors are involved, as seems likely, of every fifteen such back cross animals approximately four or 26.6 per cent. should have three; six or 40 per cent. two; four or 26.6 per cent. one; and one or 6.6 per cent. none of the four factors necessary for continued growth of the tumor. When crossed with F_1 animals these back cross types should give the following ratios of susceptible to non-susceptible animals in their progeny.

Type of Back Cross	Ratio of Susceptible to Non-Susceptible Progeny
Having three factors	1: 3.7
" two factors	1: 6.1
" one factor	1: 9.7
" zero factors	1: 15

The first two categories should be easily recognizable and together form 66.7 per cent. of the back cross animals. Such tests have now been begun.

The sex chromosome has been eliminated as a probable carrier of any of the four factors as follows. If mice like other mammals have the female XX and the male XY in formula, the use of susceptible Japanese waltzing males to form the F_1 animals used, gives daughters carrying his X, and sons his Y chromosome. If now his *sons* only are used to produce the back cross generation by mating with common non-susceptible females, all the X chromosomes in the resulting animals will be derived from common non-susceptible mice. Unless therefore, crossing over between the X and Y chromosomes occurs frequently, any susceptibility factor borne in the X chromosomes of the original Japanese waltzing males used, has been eliminated.

While further investigations are in progress, we may conclude provisionally that:

1. From three to five factors—probably four—are involved in determining susceptibility to the mouse sarcoma J. W. B.

2. That for susceptibility the simultaneous presence of these factors is necessary.

3. That none of these factors is carried in the sex (X) chromosome.

4. That these factors Mendelize independently of one another. C. C. LITTLE

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

THE fifth annual meeting of the American Association of Petroleum Geologists was held in Dallas, Texas, March 18 to 20, with headquarters at the Adolphus Hotel. The annual meeting of 1919 also was held there, and Dallas was selected for a second time because of its accessibility to the southwestern oil fields, where large numbers of members are now working. Almost three hundred members and more than a hundred visitors were registered from all parts of the United States. The association was honored by the presence of Dr. George Otis Smith, director of the United States Geological Survey, who was made an honorary member of the association. Other distinguished members present from a distance were R. P. McLaughlin, oil and gas inspector of California; Dr. Ralph Arnold, consulting geologist, of San Francisco, New York and London; Professor Roswell H. Johnson, of Pittsburgh; and Everett DeGolyer and Donald F. McDonald, of New York.

The opening session was called to order by President I. C. White, state geologist of West Virginia, well known as the father of the anticlinal theory. Greetings were given by a representative of the Oil Development Committee of the Chamber of Commerce of Dallas, and by Robert H. Hill, president of the Southwestern Geological Society, and responded to by President White.

The general subject of this session was New Mexico and Northwestern Texas. Papers were given by Dr. John K. Knox, on "The geology of New Mexico as an index of probable oil resources," by Dan L. Garrett on "The stratigraphy of northeastern New Mexico"; by Wallace G. Matteson on the "Oil possibilities of northeastern New Mexico," and by Dr. Chas. N. Gould on "Types of structure at Amarillo, Texas."

The Thursday afternoon session was devoted to a consideration of the Louisiana and Texas fields, and papers were given by Chester A. Hammill on "The structure of northwest Louisiana"; by Sid-